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(54) Corrugated sheet decking with concrete bonding projections

(57) Sheet decking for spanning supports, said decking comprises a corrugated sheet 11 the side surfaces (13.14) of at least some corrugations therein having surface discontinuities (17 Fig. 2) to aid bonding of a cementitious material to said decking, wherein said surface discontinuities (17) are elongate recesses or projections (18.19 Fig. 2) having their longitudinal axes lying in planes substantially perpendicular to the decking sheet.

FIG.1

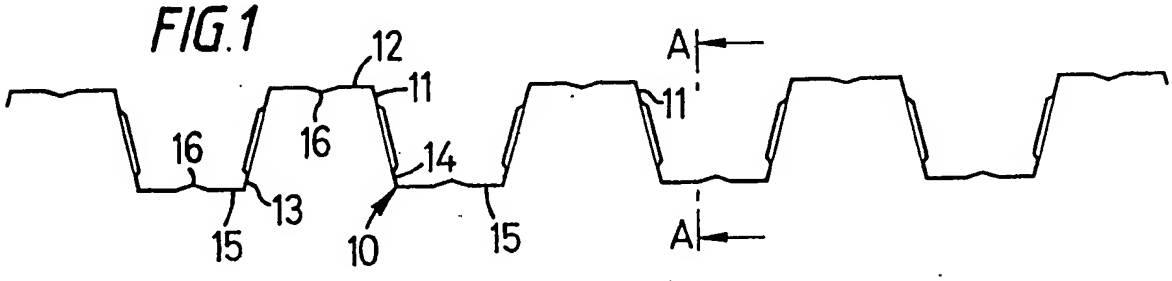

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FIG.1

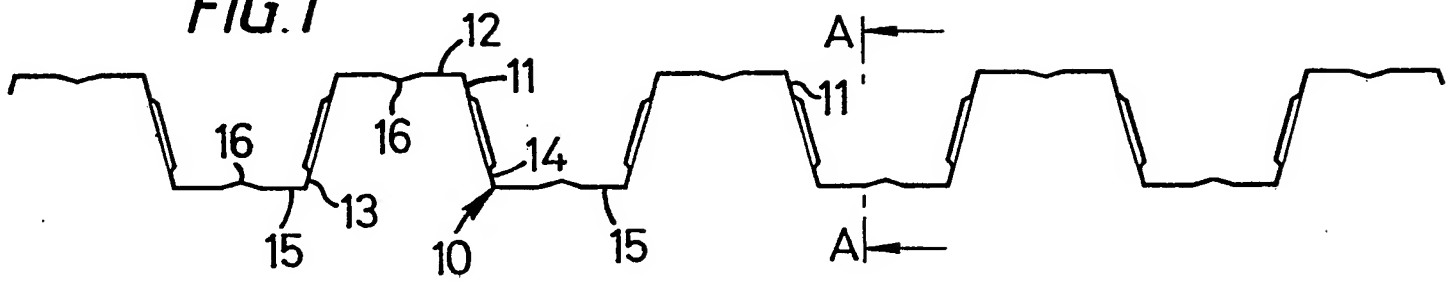


FIG.2

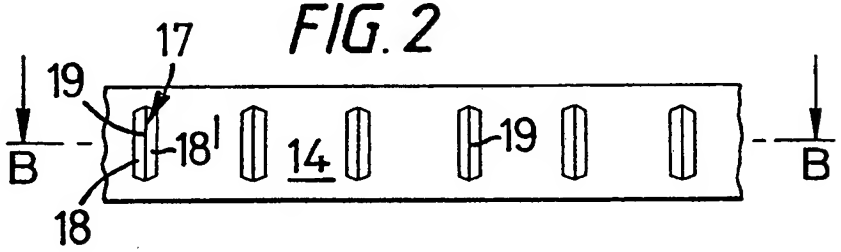


FIG.3

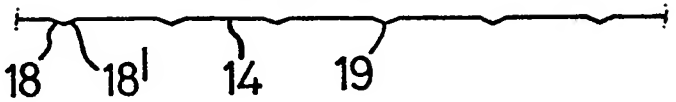


FIG.4

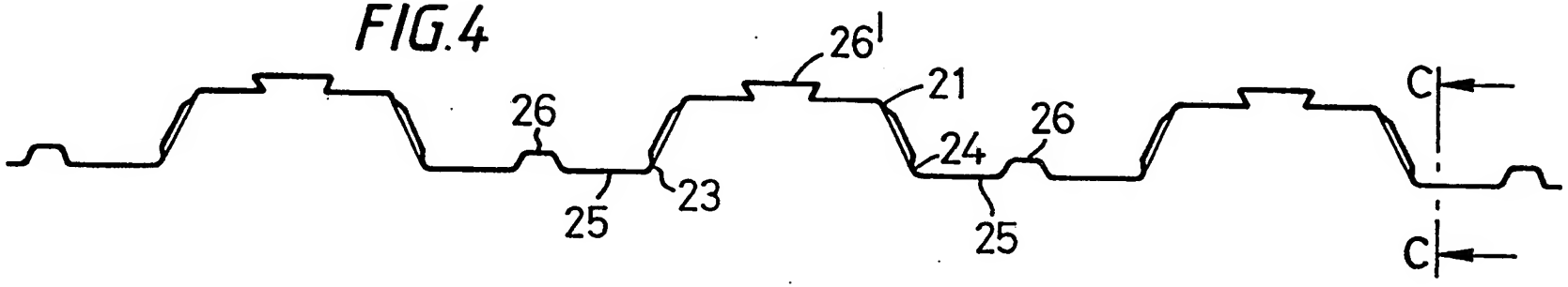


FIG.5

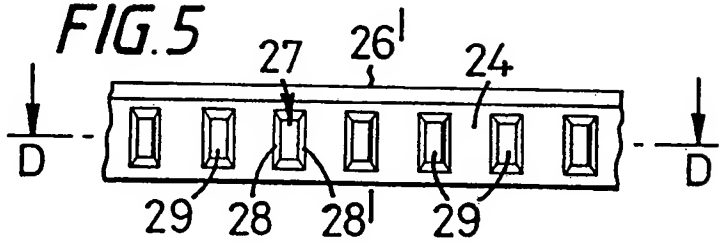


FIG.6

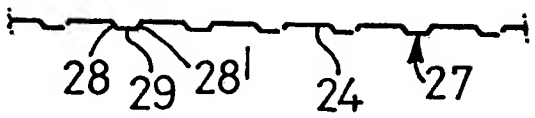
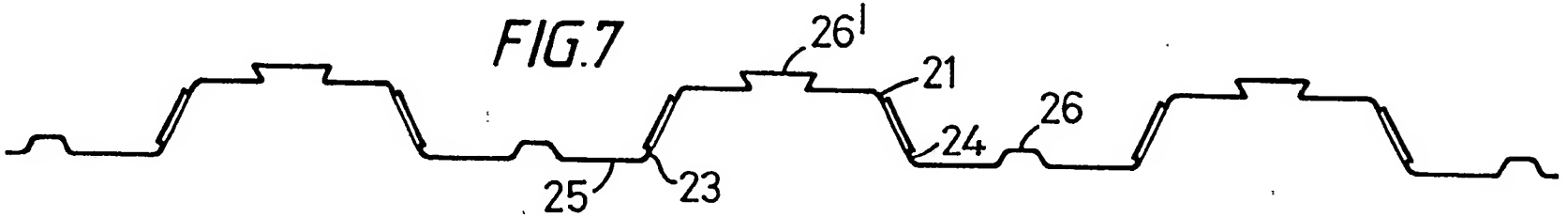


FIG.7



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SPECIFICATION

Structural member

This invention relates to structural members and has particular reference to metal decking which is used to span supports in the construction of floors and ceilings.

In the construction of buildings, it is frequently the practice to provide a layer of metal shuttering or decking extending as a span between supports during the formation of ceilings and floors in multi-storey buildings. Typically, such a composite decking comprises profiled steel sheet which is erected in position and is used as a support for a concrete layer cast *in situ*. The limitation on the span that can be supported by such decking is determined by the deflection of the decking during construction due to the loading caused by the weight of wet concrete poured onto the decking.

Our copending patent application No. 8514375 describes and claims a method of forming a structural member which comprises the steps of casting a first concrete layer to a depth less than the desired final thickness of the member and, when the first layer has hardened, casting a second concrete layer on top of the first.

This method has the considerable advantage that once the first layer has formed, it forms an integral part of the support sheet or decking and the combined strength of the decking sheet plus the first layer is then capable of supporting the wet concrete of the second final layer. This enables much increased distances to be span by a given amount of profiled decking.

In addition to easing the initial construction of the floor or ceiling, however, the profiled sheet decking also provides a longer term reinforcement for the concrete itself and it is clearly apparent to the man skilled in the art that it is desirable to obtain the maximum bonding effect between the concrete and the sheet decking *per se*.

To achieve this, it has been well known to provide a corrugated sheet decking with a plurality of dimples in side wall surfaces of the corrugations. Hitherto, these side wall dimples have been in the form of either compressions or projections which have been generally regular in shape. The present Applicants have found, however, that by carefully defining the shape and orientation of the dimples, a marked improvement in the bonding effect can be obtained.

According to the present invention, therefore, there is provided sheet decking for spanning supports which decking comprises a corrugated sheet, the side surfaces of at least some corrugations therein having surface discontinuities to aid bonding of a cementitious material to said decking, characterised in that said surface discontinuities are elongate recesses or projections, or together with an adjacent recess or projection form an elongate recess or projection, having their longituinal axes lying in planes substantially perpendicular to the decking sheet.

The sheet decking preferably has a plurality of profiled longitudinal corrugations, the sides of each corrugation being substantially planar. Each surface discontinuity may be an elongate recess or projection extending transversely of said longitudinal side wall and the inner plane is substantially perpendicular to a base part or an upper part of said decking profile. The longitudinal axes of the discontinuities should be within 10° and preferably within 5° of said perpendicular plane.

Following is a description by way of example only and with reference to the accompanying drawings of methods of carrying the invention into effect.

Figure 1 is a section through a corrugated decking sheet in accordance with the present invention.

Figure 2 is a section through the sheet on the line AA of Figure 1.

Figure 3 is a section on the line BB of Figure 2.

Figure 4 is a section through a second corrugated decking sheet according to the invention;

Figure 5 is a section through the sheet of Figure 4 on a line C-C thereof;

Figure 6 is a section on a line D-D of Figure 5; and

Figure 7 is a view substantially identical to Figure 4, but showing an alternative profile;

With reference to Figures 1 to 3; the decking sheet 10 is formed of sheet steel which is bent to provide a series of corrugations 11 extending in spaced parallel relationship across the sheet. Each corrugation comprises an upper part 12, a first inclined side wall 13 and a second inclined side wall 14, the lower extremity of each of walls 13 and 14 being connected to adjacent base portions 15 respectively. Each of base portions 15 and top portions 12 has a longitudinal extending rib 16 for strengthening purposes. Each of side walls 13 and 14 has a plurality of longitudinally projections 17, each of which is defined by a pair of longitudinal surfaces 18 and 18' inclined to the planar surface of wall 14 or 15, said walls 18, 18' converging to a ridge 19 which latter is disposed in a plane substantially perpendicular to the line of base 15.

Figures 4 to 7 show an alternative embodiment according to the invention. With reference thereto a decking sheet 10 generally similar to that shown in Figures 1 to 3 is provided, in this decking sheet a series of corrugations 21 extend in spaced parallel relation across the sheet 10. Each corrugation comprises an upper part carrying a longitudinal rib 26' in the shape of an

inclined side wall 24. The lower extremity of each of said inclined side walls 23 and 24 is connected to adjacent base portions 25 of the corrugated sheet respectively. Each base portion 25 has a longitudinally extending rib 26 of a generally upstanding arcuate configuration for strengthening purposes.

Each of the side walls 23, 24 has a plurality of longitudinal projections 27, each of which is defined by a pair of longitudinal surfaces 28, 28' which converge generally inwardly toward a planar portion 29 which conjoins the upper edges of the surfaces 28 and 29'. The longitudinal surfaces 28 and 28' and the longitudinal axis of the connecting portion 29 therebetween extend in a plane at least substantially perpendicular to the base 25.

With reference to Figure 7 the bridging portion 29 instead of being slightly convex, as in Figure 5, is planar. The longitudinal surfaces 28.28' may be formed with a longitudinal slit extending over a portion at least of the longitudinal surface thereof.

In use the decking is mounted across suitable supports and a wet cementitious composition is poured over the upper surface to fill the wells defined by each of the corrugations 11, the cementitious material encompassing each of the projections along the adjacent side walls. On curing the projections serve to assist the bonding of the material. We have found that by adopting decking having projections or recesses defined in the manner described above produces a superior resistance to separation of the decking from the cementitious material. The bonding effect is a function of the number of indentations per unit length and we have found that in a typical unit, a spacing of approximately 20 per metre along each side face produces good resistance to separation of the decking from the poured cementitious material.

In order to test the efficacy of the projections in accordance with the present invention the sheer-bond interlock provided by various sample indentations under controlled conditions were tested. In all the cases, of course, the aim is to transfer stress into the steel so that it can develope the tensile force necessary to produce a moment of resistance.

In this test re-entrant profiled sheeting, without any indentations was cut into panels 650mm long and 150mm wide with the profile centred on the longitudinal axis. The nominal profile height was 38mm and the sheet thickness was 0.9mm.

A number of different indentations were pressed into the panel webs. The different shapes of web indentation investigated were square, diamond, cross-shaped, vertical, inclined, split vertical, and split inclined. There were two nominal depths of indentation 2.6mm and 4.1mm. The number of indentations spaced equally along a 300mm section of each of the webs was varied on different panels.

Panels without indentations and with corner indentations at the web to flange intersection were also tested. In the description which follows the inclined indentations were merely vertical indentations transposed by 45°. Similarly, the cross indentations were vertical indentations transposed respectively 45° in each direction from the vertical. The split-vertical and split-inclined indentations were similarly a collocation of two square indentations on a common axis; vertically and diagonally arranged respectively.

To the panels of the present invention were applied two blocks of concrete, each 300mm long, 150mm wide and 150mm deep. Dried aggregates were used to aid mixing consistency; the mixed proportions were 0.6:1:2.37:4.03 for water:cement:sand:crushed stone aggregate; and the resulting mix density was 2350 kg/m^3.

Although such test specimens lack the rigidity which they would have had if the full width of the profile sheet had been cast, it nevertheless provided a suitable specimen for testing. Each sample was then subjected to pressure from a hydraulic jack to failure. In this test the load was increased steadily during the test until initial debonding between the steel sheet and the concrete occurred. Continual pressure was applied until a peak load had been recorded, or until a brittle failure mode had been confirmed.

The results are summarised in Table 1 following. In most cases the load increased with zero slip initially. Then followed a stage during which the slip increased slowly and partial debonding was apparent around the periphery of the panels. The tabulated failure loads were recorded when debonding was complete.

A residual sheet load could be resisted at the interface. This residual load ranged from 10% to 90% of the failure load, with the lower value achieved by the plain panel, and the higher value achieved by panels with the vertical and split vertical indentations.

TABLE 1

INDENTATIONS			FAILURE
TYPE	mm DEPTH	PER 30cm NUMBER	LOAD kN
PLAIN	-	-	9.80
PLAIN	-	-	11.60
SQUARE	2.4	2	12.22
SQUARE	2.7	3	12.22
SQUARE	2.4	6	14.15
SQUARE	4.3	3	15.81
DIAMOND	2.6	2	8.73
DIAMOND	2.6	3	12.80
DIAMOND	2.6	6	14.98
VERTICAL	2.3	3	12.22
VERTICAL	2.5	10	23.79
VERTICAL	4.1	3	18.00
VERTICAL	3.9	9	31.79
INCLINED	2.6	3	11.06
INCLINED	2.6	6	14.66
CROSS	1.9	3	10.48
CROSS	2.2	6	12.21
SPLIT VERTICAL	3.9	3	15.97
SPLIT VERTICAL	3.8	6	19.00
SPLIT VERTICAL	4.0	9	23.40
CORNER	-	3	11.30
CORNER	-	6	13.02
CORNER	-	9	14.88

It will be seen from the above that plain corrugation without indentations are plainly inferior. The performance of the indentations can be seen to be a function of the shape of the indentation, its number per 30cm. and the depth of the indentation. Nevertheless the higher values are achieved with vertical indentations (11), (13) and (20). These values result in a failure load approximately double that of the plain corrugation or corrugations bearing a diamond or cross-shaped corrugation.

CLAIMS

1. Sheet decking for spanning supports, which decking comprises a corrugated sheet, the side surfaces of at least some corrugations therein having surface discontinuities to aid bonding of a cementitious material to said decking, characterised in that said surface discontinuities are elongate recesses or projections, or together with an adjacent recess or projection from an elongate recess or projection, having their longitudinal axes lying in planes substantially perpendicular to the decking sheet.

2. Sheet decking according to claim 1, characterised by a plurality of profiled longitudinal corrugations, the sides of each corrugation being substantially planar, and in that each surface discontinuity is or together constitute an elongate recess or projection extending transversely of said longitudinal side wall.

3. Sheet decking according to either of claims 1 or 2 characterised in that the longitudinal axes of the discontinuities are within 10° of said perpendicular plane.

4. Sheet decking according to any preceding claim, characterised in that the elongate recesses or projections extend to a common ridge.

5. A sheet decking according to any of claims 1 to 3 characterised in that the elongate recesses or projections converge to support a bridging intermediate raised portion extending generally parallel with the respective corrugation.

6. Sheet decking according to claim 5 characterised in that the bridging intermediate portion is planar or arcuate.

7. Sheet decking according to any preceding claim, characterised in that approximately 20 recesses or projections are disposed in each side face per metre.

8. Sheet decking substantially as hereinbefore set forth with reference to, and/or as illustrated in, Figures 1 to 3, Figures 4 to 5 or Figure 7 of the accompanying drawings.

9. Sheet decking substantially as hereinbefore set forth.

10. A building comprising sheet decking according to any one preceding claim.

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